

(ABSTRACT)

PARALLEL COMPUTING AND MODEL EVALUATION FOR ENVIRONMENTAL SYSTEMS: AN OVERVIEW OF THE SUPERMUSE AND FRAMES SOFTWARE TECHNOLOGIES

BABENDREIER, J.

*U.S. Environmental Protection Agency, National Exposure Research Laboratory, Ecosystems Research Division
Athens, Georgia USA, email: babendreier.justin@epa.gov*

ERD's Supercomputer for Model Uncertainty and Sensitivity Evaluation (SuperMUSE) is a key to enhancing quality assurance in environmental models and applications. Uncertainty analysis and sensitivity analysis remain critical, though often overlooked steps in the development and evaluation of computer models. In land management for example, while there is a high potential for exposure of humans and ecosystems to chemicals released into the environment, the degree to which this potential is realized is to some degree uncertain. SuperMUSE helps address various computational tasks associated with various quantitative techniques used to evaluate models and modeling systems (e.g., uncertainty analysis (UA), sensitivity analysis (SA),

Unique Capability in EPA

As a result of the SuperMUSE hardware and software technology developed by ORD for the Land Program, we can now better investigate new and existing UA/SA methods, including extensive verification of codes (i.e. elucidating coding errors), parameter estimation techniques (i.e., calibration), and evaluation of model performance (i.e. model validation). SuperMUSE is relatively unique in its ability to facilitate UA/SA of complex, Windows-based models, conducting analyses that had to date been impractical to consider for larger Windows-based modeling systems.

How SuperMUSE Is Put Together

SuperMUSE is currently constructed from a collection of network computing switches and 400 personal computers (PCs), which support both Linux and Windows 98/2K/XP/2003 operating systems. It has been constructed from a mix of new PCs and older "excessed" equipment. The system is currently comprised of 10 servers, a primary bank of 382 "client" PCs, and an experimental testing bank of 8 client PCs called MiniMUSE. An expansion to 400 PCs was completed in 2005, and in early 2006 saw an infusion of 225 new PCs to replace older equipment. This brought the total equivalent computing capacity of SuperMUSE to over 1000 GHz. Dual-boot Windows/Linux capabilities as well as supporting hardware infrastructure has been continuously enhanced since the projects inception in 2001. A conceptual layout of SuperMUSE hardware is shown in Figure 1.

Windows and Linux Support

Historically, the Agency has relied heavily upon Unix and Linux based operating systems to solve high performance computing problems. In juxtaposition, most Agency model developers and users are familiar with and reliant upon Windows-based operating systems. While the need for UA/SA to evaluate environmental models continues to grow, investigation of Windows-based models had historically been limited by a lack of Windows-based

supercomputing capacity. The largest cluster in EPA, SuperMUSE helps fill this gap by providing parallel computing capabilities in both Windows and Linux environments. SuperMUSE is comprised of both a large cluster to facilitate ERD's ongoing research into various UA/SA methods and models, and a supporting software system that can be transferred to other clusters/grids.

The SuperMUSE software, developed by NERL/ERD, can be applied in any PC network environment, and is generally extendable to performing UA/SA on any PC-based model.

FRAMESv2 Support

A specific SuperMUSE interface was developed for FRAMESV2, and is known as the FUITasker. An extensive suite of additional "Systems" tools are also now available in FRAMES Version 2. Together with SuperMUSE 1.0, the software sets can be used for conducting various UA/SA/PE studies. A discussion is presented with various examples of the software, along with key aspects of design. The software additions and joint capabilities allow leverage at both single desktop and cluster scales (e.g., certain functionality available for use by 1 PC, also supports use by 2-1000+ PCs).

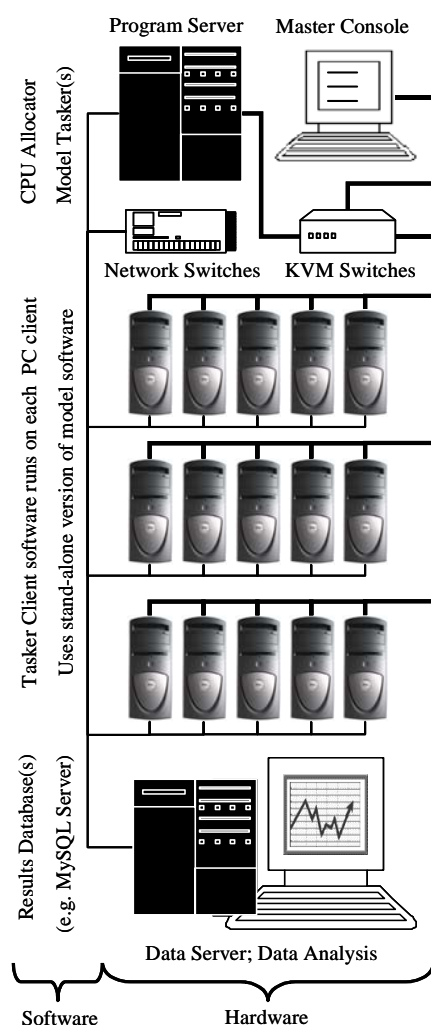


Fig.1: SuperMUSE Conceptual Layout